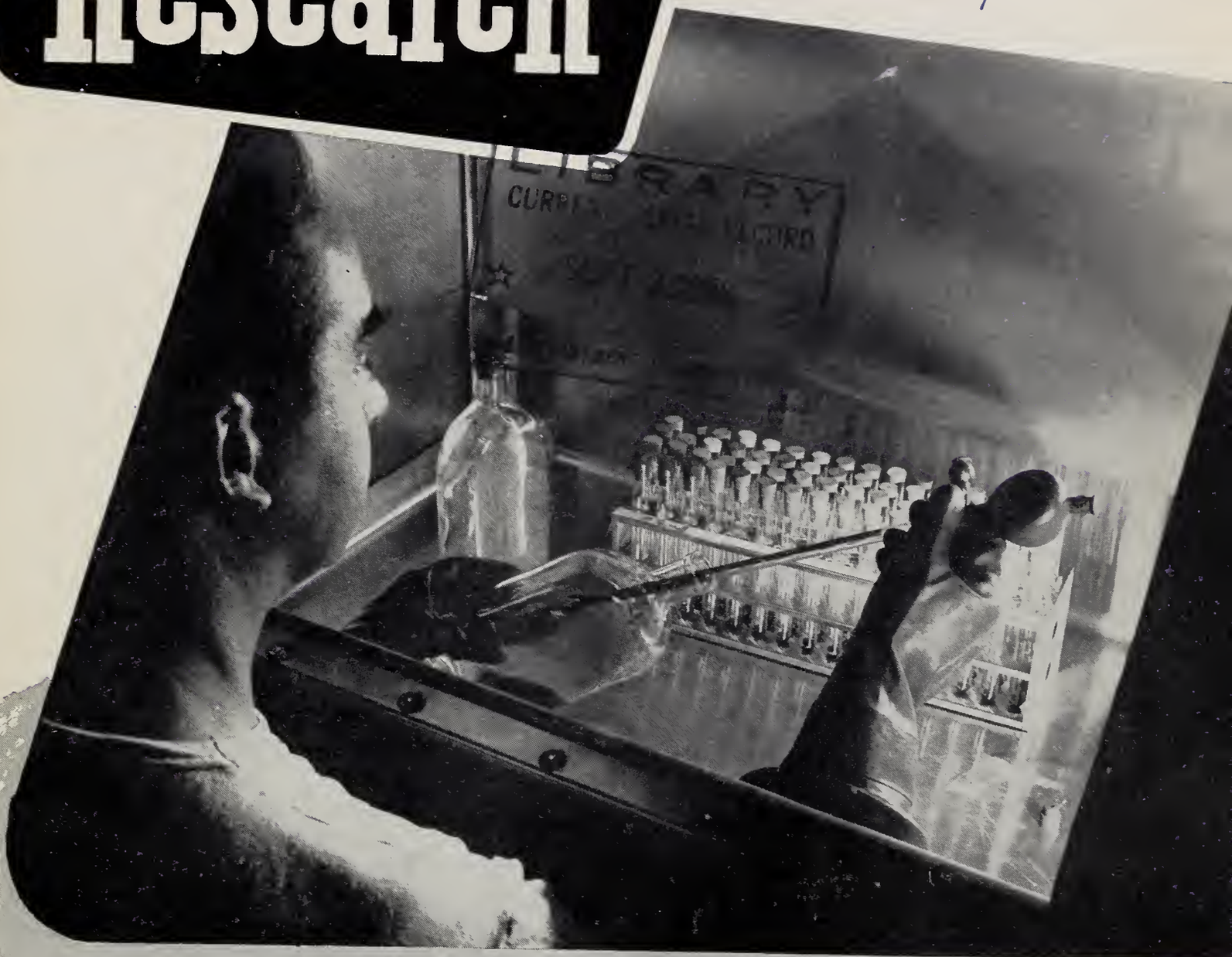
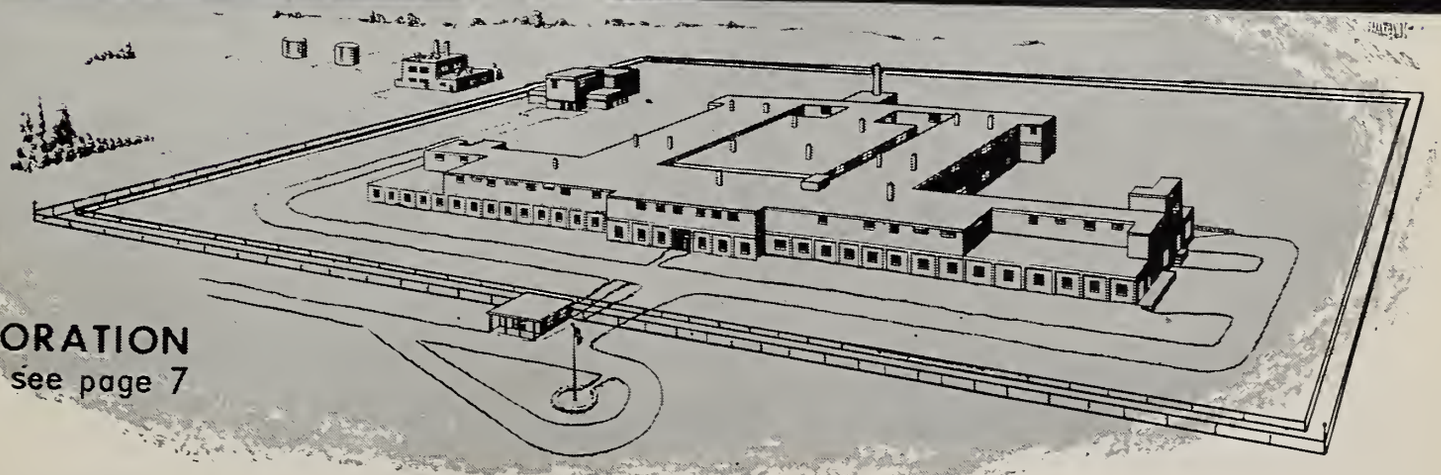
AGRICULTURAL Research

SEPTEMBER 1956





EXPLORATION
see page 7

UNITED STATES DEPARTMENT OF AGRICULTURE

AGRICULTURAL
Research

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CONTENTS

DAIRY

Weigh-a-Day-a-Month _____ 3
What About Milk Margins?_____ 4

CROPS AND SOILS

Fresh Sugarcane's Worth More_____ 5
Finding New Crops, Saving Old Stocks___ 6

LIVESTOCK

Open House on Plum Island_____ 7

FRUITS AND VEGETABLES

When to Bark Feed_____ 11
Amazing Gibberellic Acid_____ 12

POULTRY

How Turkeys Respond to Added Fat_____ 13

FOOD AND HOME

Poultry Processing and Tenderness_____ 14
Institution Food Losses and Diets_____ 14
We Want Still More Processed Foods_____ 14

AGRISEARCH NOTES

Help Wanted at Plum Island_____ 16
Home Economists Visit Beltsville_____ 16
New Clothing, Housing Research Chief____ 16

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Influence

High-school teachers of science, mathematics, and vocational agriculture are one of our most vital groups today. Our future depends heavily on their ability to influence young men and women to choose careers in the sciences.

Competition for brainpower is terrific nowadays. What has happened is that science and technology have paid revolutionary returns in recent years. These spectacular advances have brought new appreciation of scientific talent.

Numberless research problems challenge science today. They can be solved only by men and women trained in the basic sciences. Yet, we are producing only 45,000 scientists and engineers a year—half what we could use.

This hurts in agriculture, which draws on all the sciences. We need 15,000 new, trained people each year. But only 8,500 will get degrees in the agricultural sciences in 1956.

Demand for talent has suddenly increased—will increase still more as our population grows and science develops.

But *supply* hasn't kept up. Of the young people who finish high school this year, only about half will enter college. Only 2 out of 3 of the brightest will attend. Furthermore, about half those who do start won't finish. Altogether, of 100 youths who enter school today, only 13 graduate from college, only 3 in engineering and science.

This situation calls for increasing investments in education. We need to see that talented students get a chance to continue their education, to train teachers to recognize these talented individuals early. We need to strengthen high school science offerings. We need to make teaching more desirable—the teacher shortage is one of our main difficulties.

We can—and must—find ways to attract youth into scientific studies. You in teaching play a vital part because it's from you that potential scientists get their first real taste of science. Yours is the opportunity to encourage those who show aptitude, to fan the flame of their curiosity.

The way you do your job will have much to do with the direction they take. And it will influence the direction our country takes in meeting the challenges of this age.

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AGRICULTURAL RESEARCH SERVI
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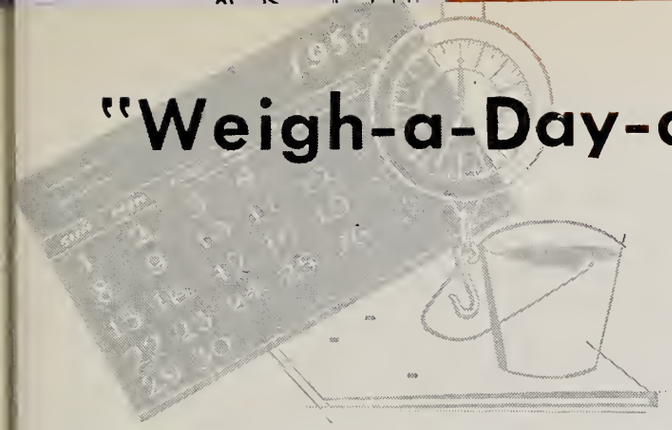
"Weigh-a-Day-a-Month"



dairy

THIS SIMPLE, LOW-COST RECORDKEEPING PLAN CAN HELP MILLIONS OF DAIRYMEN INCREASE THEIR PROFITS BY CULLING AND FEEDING EFFICIENTLY

A NEW, simplified dairy recordkeeping plan is being offered to the country's dairymen this fall by USDA as a means of increasing dairy-farming efficiency and profits.

Known as the "Weigh-a-Day-a-Month" plan, it's an addition to the widely known standard plan and the owner-sampler plan of recordkeeping under the national cooperative Dairy Herd Improvement Association program. The plan is a low-cost method of providing dairy farmers with milk production records for use in (1) culling low-producing cows, (2) feeding according to each cow's production, and (3) selecting the best animals to raise herd replacements.

The plan reduces the farmer's recordkeeping job to the single essential of weighing each cow's milk production, morning and night, once a month. Weighing of feed is optional, and no milk sampling or butterfat testing is required. The total milk production for a day for each cow in his herd is entered by the farmer on a special form, which he sends to a local-area computing office.

Only cost to the dairyman—about 50 cents per cow per year—is that of calculating the monthly milk production, total production to date for each cow, and the yearly herd total to date. Once calculated, the records are returned for the farmer's use in determining the steps necessary to improve his herd's efficiency. If feed information is reported, the value of the product, total feed cost, and income over feed cost for the herd will also be calculated for the farmer.

The new plan is designed to supplement the 50-year-old Federal-State Dairy Herd Improvement Association program (AGR. RES., October 1955, p. 14) under which official milk production records and butterfat tests are made by association supervisors once each month. It will also supplement the owner-sampler plan that has operated in several States and territories for a number of years.

Production records and butterfat tests are currently being taken for about 1,400,000 dairy cows under the DHIA program. The owner-sampler program presently applies to production recordkeeping and butterfat testing for about 375,000 cows. Hope is that the Weigh-a-Day-a-Month plan may eventually be the means of production recordkeeping for an additional 8 to 10 million cows.

Expansion sought in these recordkeeping programs has the ultimate goal of production records for about 12 million cows—roughly 50 percent of the country's dairy herd.

The ARS Dairy Husbandry Research Branch has drawn on experience gained in several States, particularly Illinois, in formulating the new, low-cost, Weigh-a-Day-a-Month plan.

Approved recently by the American Dairy Science Association and the Extension Committee on Organization and Policy, the plan recognizes the need for greater dairy-herd efficiency through culling of low-producing cows. Neither culling nor efficient feeding can be done effectively unless the dairyman has the production record of each cow in his herd.

USDA and State dairy officials are convinced that small dairy farmers, with such records, will be able to trim their herds for greater profit with fewer cows. The low-producing cows are costly to dairymen. And they suffer a double profit loss when such cows, collectively, provide excessive market supplies of milk.

Milk production costs decrease steadily as milk output per cow increases. Return over feed cost averages only $136 for a cow that produces only 5,000 pounds of milk a year. Her feed cost will average about $2.72 for each 100 pounds of milk. A cow producing 11,000 pounds annually will show a margin of $272 over feed cost on the average. Records show her feed cost per 100 pounds of milk will average $1.78.

ARS dairy researchers point out that cost figures such as these become more meaningful to dairymen who have an opportunity to check them against actual production records in their own herds. The new low-cost program is expected to make the value of the two broader programs more obvious to the farmer who has not previously used production records.

Weigh-a-Day-a-Month's major purpose is to make recordkeeping available to an estimated 90 percent of dairy farms having 14 cows or less, although it can also be used by farmers with larger herds. It is being supervised by the Extension Service in each State and directed by county agents at the farm level. Signup of farmers who wish to participate is underway at the present time. ☆

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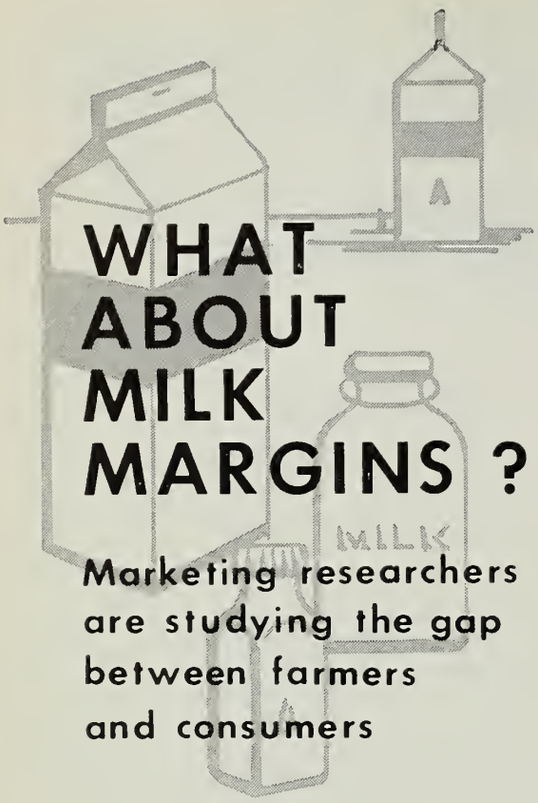


WHAT ABOUT MILK MARGINS ?

Marketing researchers are studying the gap between farmers and consumers

FARMERS and farm leaders have been showing an understandable livelier-than-usual interest in marketing margins—those elusive gaps between what the farmer gets for his products and what the consumer pays for them. The increased concern has resulted in intensified USDA research on widening market margins. Much of this recent effort by the Agricultural Marketing Service has been on dairy products, particularly fluid milk.

Dairying margins were not hard to figure out in the days when milk was sold primarily just as milk in single quart bottles delivered to consumers' homes. Things are no longer the same. Long-established trends in marketing have been giving way to new developments reflecting the tastes and habits of American consumers. Now, there are homogenized and special milks as well as regular milk. Half-gallon and gallon containers are growing in use. In Chicago and Akron, milk sold in gallon jugs constitutes one-third of all fluid milk sales. In some other markets, up to half of the milk is sold in half gallons. Sales of milk in glass containers are declining. Use of bulk dispensers in restaurants is gradually increasing.

As if this were not enough, retail stores are now more in the picture, too. Independent routemen are numerous in some markets. Also, at the country end, receiving stations and over-the-road transportation are often owned and operated independently.

These new price-spread complications are currently under intensive study in the Chicago market. AMS researchers eventually expect to cover other cities as well, to get an indication of who gets what share of consumers' money spent on fluid milk.

Another important aspect of this research on fluid-milk marketing margins is a continuing study of operations reports of 80 dairy plants. These reports are received quarterly and analyzed. Results are published as USDA reports at intervals. Reports now being prepared will show changes in marketing costs over the last 4 years. They will also show how trends may differ among firms of different sizes from all over the country.

Data so far show that individual firms, almost without exception, have increased their volume of business from 1952 to date. Further analysis will show differences in costs among different types of firms. For example, firms specializing in retail trade will be compared with firms specializing in wholesale trade. A comparison of glass and paper milk containers will be made, and the relationship between volume of business and distribution of costs will be analyzed.

While present research on fluid-milk marketing margins forges steadily ahead, past work has already resulted in much valuable information.

Agricultural Economist L. F. Herrmann and his associates found out that between 1950 and 1955, the margin on single quarts of milk delivered to homes went up 27 percent. On single quarts sold through stores, however, the margin went up only 21 percent. Margins on milk in gallon jugs averaged lower than on half gallons and single quarts. It is doubtful if the gallon jug is a less costly form of packaging than the single quart, but the pricing of gallon jugs may be explained on the same basis as quantity discounts offered on single quarts. These discounts were given on home-delivery routes in 77 markets.

Margins on 2-quart and 4-quart purchases of milk were lower than on single quarts. But the margin on single quarts was higher in cities having a discount plan than in cities without such a discount. AMS economists say that fluid-milk margins could be more accurately measured on the basis of an average size of purchase rather than on a single quart.

On the basis of single quarts, the retail price of fluid milk in the 3 years 1947–49 in this country averaged 19.9 cents a quart. Farmers got 10.6 cents, leaving 9.3 cents for distribution. Last year, out of a retail price of 22.9 cents, farmers got 10.2 cents, and 12.3 cents went for distribution. A familiar story of rising costs and lowering receipts for farmers is told by these figures. They show need for more analysis to determine further price breakdown In addition, they establish the basis for making constructive recommendations on price changes where necessary.

AMS researchers are studying not only margins but also what it costs to market fluid milk. Greater efficiency for processors and distributors should come about as a result.

In the future, we should be able to know the comparative costs of packaging milk in different types of containers. We should know the costs of dispensers and half-pint packages in institutional food service, the economies of compulsory dating of pasteurized milk, and the costs and accuracy of alternative ways of sampling and testing milk for butterfat. ☆

FRESH SUGARCANE'S WORTH MORE

GROWERS, PROCESSORS BOTH MAKE MORE IF CANE IS GROUND AS SOON AS POSSIBLE AFTER CUTTING

SUGARCANE growers can be at least $5 an acre ahead for every day they save in getting fresh, hand-cleaned cane to the grinding mill.

If they can get it there within 24 hours, their sugarcane could be worth $42 an acre more than cane that's left in heap rows for 9 days.

Experiments at USDA's Southern Utilization Research Branch, New Orleans, La., show that processors also can gain by more efficient handling of the fresher, higher-quality cane.

Two-year tests (1954 and 1955) were conducted to determine the value of fresher sugarcane to both growers and processors. Eight lots of sugarcane were used, including both plant and stubble of several new varieties that will soon see wide commercial use, and the widely known C. P. 44–101. The dollar value of prompt sugarcane delivery was computed on the basis of an average yield of 25 tons an acre. Test results for both years were substantially the same.

Differences amounted to $134 more per 100 tons for fresh cane compared with 5-day-older cane, and $156 more per 100 tons compared to the return from cane 8½ days older.

Average loss in keeping cane in heap rows for 5 days after cutting amounted to 15 percent of the recoverable sugar and reached almost 22 percent in about 8½ days. This is caused by loss of weight, decrease in sucrose content, and drop in purity due to inversion. (Inversion is the change from sucrose, which is the sugar used for home consumption, into dextrose and levulose, the less economically important "invert sugars.")

Average weight losses were 8 percent of the freshly harvested weight after 5 days, and over 10 percent after 8½ days in heap rows. Drop in purity was from 69.2 percent to 65.4 in 5 days, and to 63.8 in 8½ days. Sucrose content dropped from 9.7 percent to 9.2, and finally to 9.1 in the course of the experiments.

The drop in purity is the principal factor other than weight loss in reducing the recoverable sugar, impairing cane quality, and reducing the value of cane that is not ground as promptly as possible after cutting.

The problem is complicated by the fact that cane must be dried after cutting to permit more efficient burning, which cleans out leaves and trash. Growers must compromise between the time-consuming but necessary drying process, and the need for fast cane delivery to the mill for best sugar and highest financial returns.

Largest possible financial gain to growers could be realized by grinding only unburned, clean, fresh cane. The combination harvester-cleaner-loader can deliver such cane within 24 hours, ARS scientists say.

Nearly all sugarcane growers, however, still clean their cane by burning. Another method is to hand-clean the cane. This is probably more thorough but is also less economical, especially on a large scale.

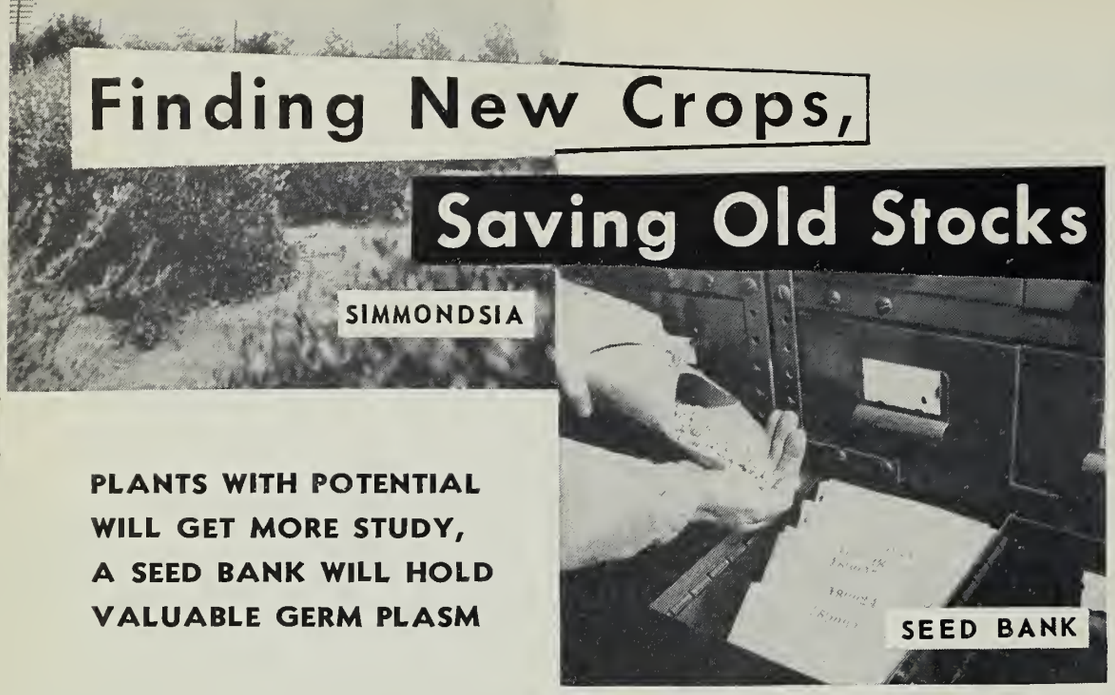
Many researchers feel that the burning process causes too much sugar loss, and much evidence points in this direction. Future research should provide a definite answer—one that could mean more and better sugar at a saving to consumers. ☆

HARVESTER cuts cane row (left). Carrier extends to right of harvester, combines cane from several rows, piles it into heap rows. Cane in heap rows is dried and then burned.

BURNING cane to get rid of trash and insects insures clean cane. Four-jet oil burner is typical of kind used. Cane burns for 15 or 20 minutes, depending on its dryness.

SHREDDING of cane takes place in grinding mill. Sugar is removed in water solution; sugarless cane, known as bagasse, finds many commercial uses—such as litter, paper, feed.

Finding New Crops, Saving Old Stocks



PLANTS WITH POTENTIAL WILL GET MORE STUDY, A SEED BANK WILL HOLD VALUABLE GERM PLASM

DEVELOPMENT of profitable new crops and preservation of valuable breeding stocks to improve our old crops will get added emphasis in USDA crop research this year.

Intensive study will be started on three potential crops—*Dioscorea, Simmondsia,* and the timber bamboos. All of these have possibilities.

And a new seed bank (National Seed Storage Laboratory) will be built in Colorado for the long-time retention of plant species collected abroad or from the wild for use in developing better crops of all kinds.

The seed bank, for which Congress recently appropriated $450,000, will be built on a campus site donated by Colorado A and M College at Fort Collins. It will house the permanent seed collection of all introduced species still remaining from six decades of plant exploration as well as breeding stocks recommended as of possible value for the future. Many of the collections have been lost because we lacked space and opportunity to preserve and revitalize them. Some plant sources are inaccessible now. Future accessions of plants reproducable through seeds will be stocked at the Colorado laboratory so long as there's any likelihood of their usefulness as crops or breeding material.

C. O. Erlanson, in charge of the plant introduction work in ARS, anticipates that in the years to come the laboratory will serve as a repository for many of the close wild relatives and primitive varieties of our important crops. These plants contain characters such as disease resistance that may be valuable in developing new commercial varieties. Erlanson cites the history of clover introductions: of the thousands of breeding lines introduced since 1898, only 1 out of 50 is now available.

Some seeds are short-lived and others are quite long-lived. But most of them can be kept far longer—even up to several decades—in a dry atmosphere and at cool, uniform temperatures. The laboratory will provide those ideal conditions as far as possible. The seeds will be tested from time to time, and whenever deterioration shows up they will be grown out to get fresh replacements.

The laboratory will maintain active contact with researchers likely to have use for the introduced species in breeding work. Thus, seed stocks will be discarded only after making certain they have no further value.

The laboratory will also maintain a sort of master file of worthwhile plant varieties to guard against their discard and the loss forever of potentially valuable germ plasm. Many of our old varieties of maize, fruits, and other crops have been superseded by new ones and lost—which kills the opportunity of again examining those old varieties for genetic characters needed for new problems.

The Colorado laboratory has the job of maintaining the permanent deposit. But most of the same materials will be available for use through the four regional plant-introduction stations run cooperatively by ARS and the State experiment stations, and through other research channels.

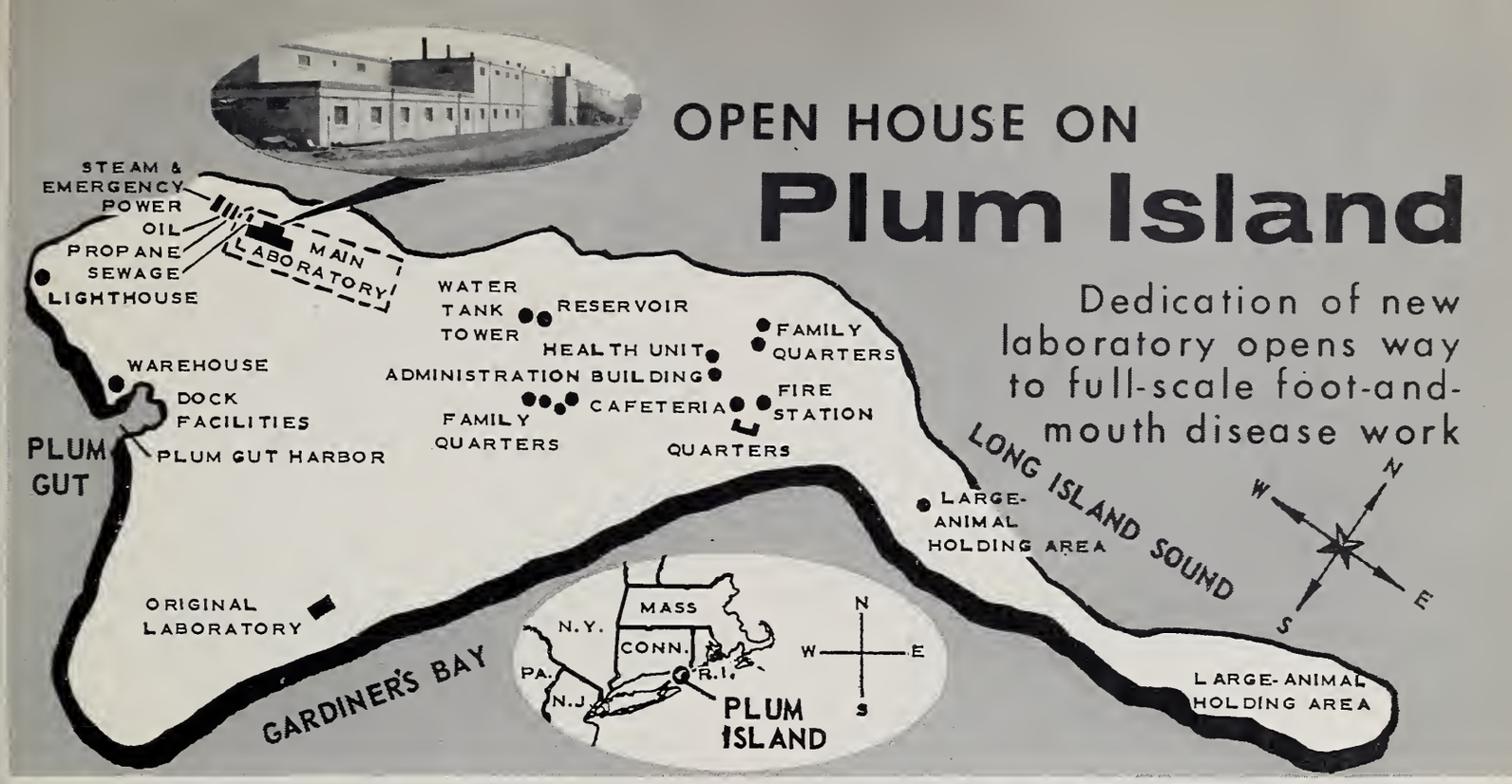
Some study has already been made of the three plants viewed as potential new crops. The *Dioscorea* family of wild tropical yams, which contain source materials for the anti-arthritic hormone cortisone, have been collected and tested to find productive, high-quality stocks (AGR. RES., January 1950, p. 8). *Dioscorea* will now be tried on a substantial scale under cultivation to perfect a method of growing it profitably.

Timber bamboos have proved successful for several purposes in ARS experiments (AGR. RES., August 1954, p. 12). Bamboo will now be grown under cultivation to determine its potential as a new crop.

The third plant, *Simmondsia chinensis,* a native desert shrub growing in our Southwest and parts of Mexico, yields an abundance of hard wax that can substitute for imported oils and waxes. Extensive seed collections will be made in the early future preparatory to field and chemical testing. Studies have shown that this plant's waxes are satisfactory substitutes for imported sperm oil and carnauba wax, possibly for ouricuri oil, in a number of industrial products. Those materials are sometimes scarce. *Simmondsia* might therefore provide a profitable use for several thousand acres of southwestern dry land if it can be economically produced. ☆

OPEN HOUSE ON
Plum Island

Dedication of new laboratory opens way to full-scale foot-and-mouth disease work



PLUM ISLAND, one of the world's great reseach centers for study of foot-and-mouth disease, is about 1½ miles off the eastern end of the North Fork of Long Island, N. Y. The 800-acre island is about 3 miles long and 1 mile wide at its widest point. Orient, L. I., is nearest town, but Greenport is nearest railway station. First privately owned, the island later became U. S. property and was used by Coast Artillery, Army Chemical Corps. In 1954, island was transferred to USDA. New laboratory building, shown above, houses animal isolation units and four laboratories in wing behind long main wing. First floor houses media preparation, glass washing, shops, first aid, laundry, receiving and storage. Feed corridor, through which animals receive their feed, is on second floor at right behind the main wing.

DEDICATION of the Plum Island Animal Disease Laboratory this month will launch our most intensive fight against dangerous foreign diseases of livestock.

During the week of September 24–28, Director M. S. Shahan and the staff at Plum Island will be hosts to local citizens, farm and civic groups, Federal and State officials, press, radio, and television representatives, and prominent scientists from the United States and abroad. Secretary Ezra Taft Benson will speak at the dedication ceremonies, which are scheduled for Wednesday, September 26.

At the week's end, the Laboratory will be closed to the public, and Plum Island—off the coast of Long Island, N. Y.—will become a fortress for fundamental research on foot-and-mouth and other foreign infectious diseases that threaten our livestock and food supply.

Major emphasis of the Plum Island Laboratory research program is on foot-and-mouth disease, considered the world's worst animal plague. It attacks all cloven-footed animals—cattle, hogs, sheep, goats, deer, elk, buffalo, antelope, and moose. The disease is caused by a virus so small that it has been seen only by the powerful electron microscope. It is highly contagious and can be carried mechanically by people, animals, feed, equipment, vehicles—in fact, by any contaminated object.

Nine outbreaks of foot-and-mouth have occurred in this country, from 1870 to 1929. By vigorous eradication and quarantine measures, we stamped out each outbreak before it reached epidemic proportions. The cost in direct expenditures was heavy. Even heavier were the indirect losses because of disruption of business by quarantine

STAFF of Plum Island Animal Disease Laboratory sit in planning session (l-r): Jacob Traum, consultant, G. E. Cottral, safety officer; J. J. Callis, head, research operations; L. B. Shanks, head, administrative management; M. S. Shahan, director. About 500 people will be employed here—50 on the technical staff and the others engaged in technical assistance and various other support operations.

OPEN HOUSE ON

Plum Island

restrictions and interruptions in marketing, transportation, feeding, and slaughtering operations.

We worked closely with Mexico to eradicate the disease there in the years 1947–52 and 1953–54. Specialists from this country were invited to observe the eradication program in Canada in 1952. These recent outbreaks in Mexico and Canada are a reminder of the constant threat of this dread infection to North America.

When the disease broke out in Mexico, the need for more knowledge became urgent. On the recommendation of the Advisory Committee on Foot-and-Mouth Disease Research, the Department in 1948 sent specialists to Denmark, Holland, and England to work in foot-and-mouth disease laboratories in those countries. The Committee also recommended that these cooperative studies be supplemented by full-scale research in the United States.

Several considerations prompted this recommendation. The Committee felt that more progress could be made in facilities under our own control. In addition, the goals of our country and European countries were different, making desirable our own research tailor-made to fit our needs. European countries were interested in fast, effective control of sudden widespread epidemics and in fast production of large quantities of vaccine. Our interests were in effective prevention of the disease and in rapid eradication of any outbreak. Also, virus-free animals were more readily available in this country, and European research facilities were found to be rather limited.

After thorough consideration of recommendations from all interested groups—both public and private—the Congress in 1948 authorized the Secretary of Agriculture to establish a laboratory "for research study in the United States or elsewhere of foot-and-mouth disease and other animal diseases which in the opinion of the Secretary constitute a threat to the livestock industry of the United States." The legislation restricted the location of this proposed laboratory to a coastal island separated from the mainland by deep navigable water and not connected to the mainland by a tunnel. A survey was made of coastal islands, and in 1952 Plum Island was selected as the site. Plum Island—located off the eastern end of the North Fork of Long Island—is ideailly situated.

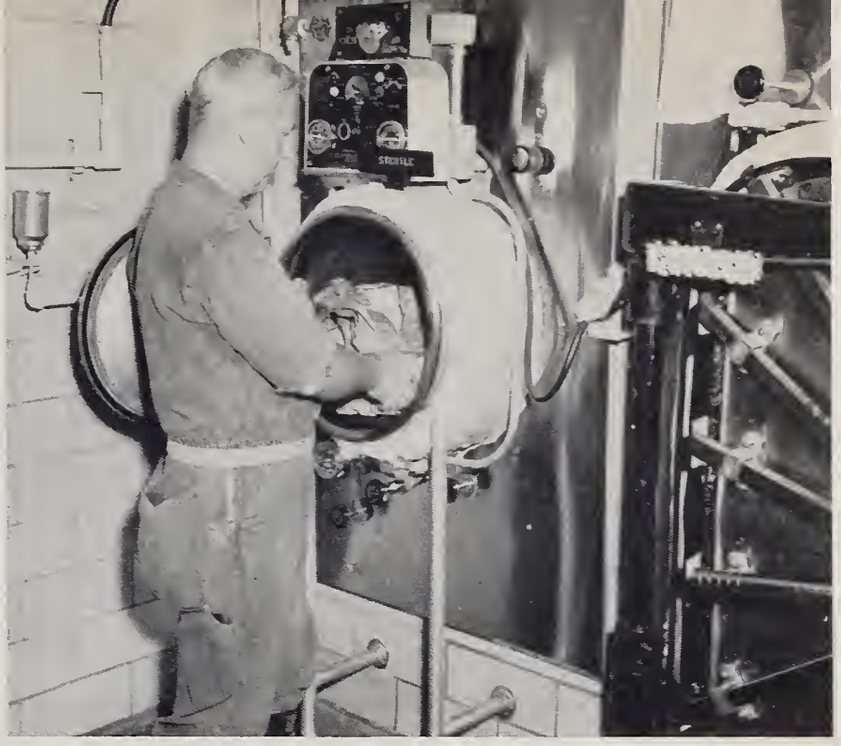
In 1954, USDA started limited research in existing facilities that had been remodeled and adapted for safe use. At the same time, construction was started on a new laboratory building—to cost 10 million dollars—that would incorporate the most modern features for conducting research on the highly contagious foot-and-mouth virus. Outstanding American and European scientists, long experienced in animal-disease research, contributed their knowledge in solving major engineering problems in insuring against escape of the virus. The laboratory has just been completed. The original small laboratory permits research on only 1 disease virus at a time, but the new laboratory provides facilities adequate enough for simultaneous studies on as many as 4 different viruses.

The entire operation on the island is geared to safety against escape of infectious agents being studied; the re-

1. All personnel, supplies, equipment, and animals are transported to Plum Island by ferry, which makes two round trips daily between the island and Orient Point, L. I. Government truck carrying healthy cattle is backed aboard this commercial vessel for the 1½ mile trip over water. Isolation of research facilities on an off-shore island, as required by law, is an important security measure. Federal control of the island with no normal traffic facilities to the mainland makes it possible to control all movements to and from and on the island.

2. Cattle received for laboratory are sprayed with insecticidal solution to destroy external parasites before being trucked to quarantine areas, and once again before entry into the laboratory. They stay in quarantine for 14 days. Trucks moving cattle from the mainland to the island are never permitted beyond the fenced-in dock area. Private automobiles are not allowed; movement of Government vehicles is restricted. Strictly controlled introduction of animals and materials represents one of the major safety precautions at Plum Island.

3. Cattle from quarantine area move up this outside ramp and through an air lock at top to enter the Animal Disease Laboratory. Once inside the building, animals are never allowed out again. Windowless laboratories are air conditioned. Air locks prevent air movement inside to outside; rooms are disinfected from inside before the air lock is opened to outside. The animal rooms are disinfected after every use. Air-conditioning-system exhaust is filtered before going outside. A double rodent-proof fence surrounds the laboratory building.



4. All material received into the USDA Animal Disease Laboratory building at Plum Island passes through autoclaves or double-doored rooms. Door of the larger autoclave appears at right. Experimental equipment, instruments, records, and noncombustible waste materials that must be removed from the laboratory are autoclaved or otherwise decontaminated before being taken outside. Material, equipment are removed from the laboratory building only when absolutely necessary, thus assuring the least possible amount of contact with the outside.

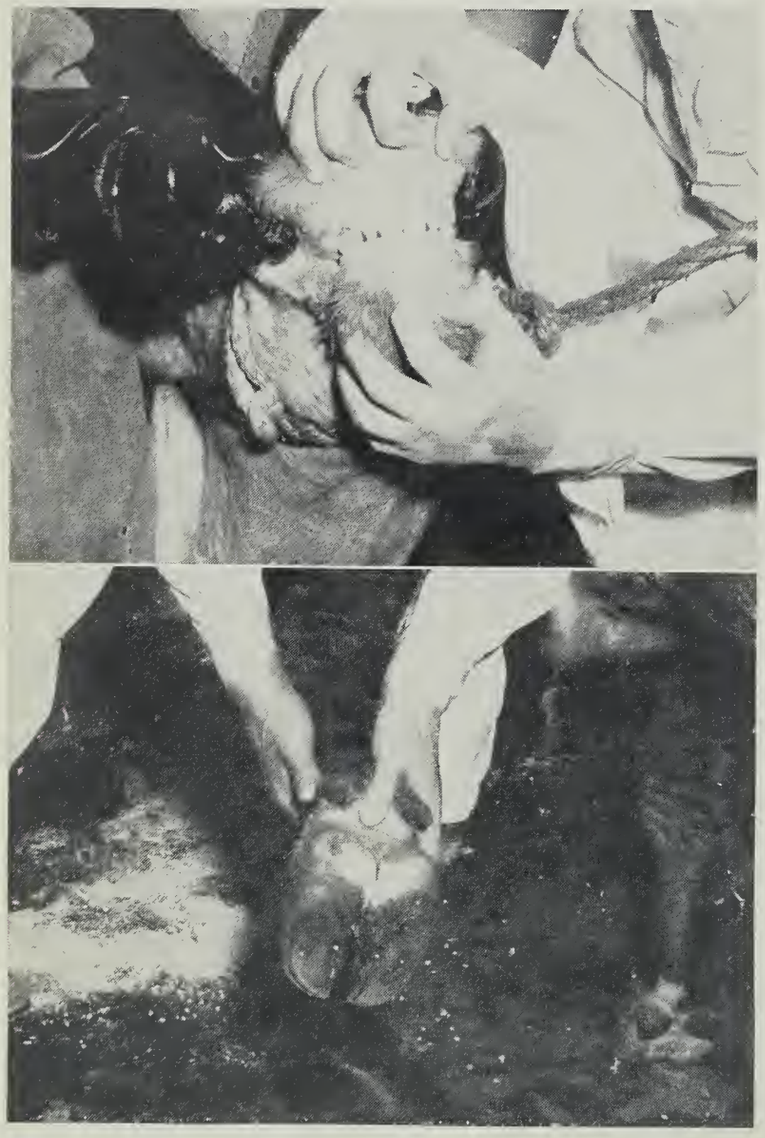
5. Sewage-sterilizing operations at research laboratory are checked by operating engineer. All sewage is heat treated to destroy all disease organisms, making sewage safe for normal disposal in offshore waters. All solid waste materials, including animal carcasses, are destroyed by incineration within the research laboratory. The main laboratory has 2 incinerators, each capable of burning 2,000 pounds per hour. Liquid waste is sterilized by heat before being discharged as sewage. Two identical sewage systems safeguard these operations.

6. Cleanup operations include washing, disinfecting of walls, floor, and ceiling of animal rooms after each use, and showering of all employees before leaving laboratory. All belongings—such as clothes, money, jewelry, glasses—must be left in an outer locker room before entering the research building. Special laboratory clothing is worn in each area of the laboratory; person must shower and change into different clothing when entering different areas. All sewing, repair, and laundering of laboratory clothing is done within main building.

OPEN HOUSE ON

Plum Island

SYMPTOMS of dread foot-and-mouth disease show up as blisters on tissues like the mouth membranes, around the top of the hoof, and between the claws of the feet. Blisters break, leaving a raw, eroded surface, as shown in the afflicted animal's mouth. Excessive salivation occurs in cattle, causing them to drool. When the feet are affected, animals limp painfully or lie down. Mortality varies but is generally less than 5 percent and occurs mostly in young animals. Greatest amount of damage to herds comes from general loss in condition and permanent impairment such as mastitis and loss of fertility.



KIDNEY-CELL suspension is poured through cheesecloth into centrifuge tube as one step in preparation of medium for foot-and-mouth disease virus growth. This fast and inexpensive method of producing the virus for research work was developed at Plum Island. It utilizes beef kidneys, easily obtained. After kidney-cell suspension is prepared, cells are mixed with a special nutrient solution, put in flasks and test tubes and incubated, then inoculated with the disease virus (see cover picture). Flasks are used for production of virus; test-tube cultures are used for virus diagnosis and potency assays.

search structures are considered the world's safest for work on animal virus. Safety is insured by complete and strict control of all equipment, animals, personnel, vehicles, and materials to and from as well as on the island.

The Laboratory's job comprises researeh and serviee.

Research—the major responsibility—is directed toward study of virus causing foot-and-mouth and other foreign animal diseases; how they spread; and better methods of virus propagation for vaccine studies. The research includes a study of diagnostic proeedures and how to improve them; better methods for differentiating virus diseases; suseeptibility of various animals and the part they play in spreading and perpetuating the diseases. Research is directed also toward disinfection of contaminated premises and materials and how to improve methods, and preventive measures, including immunization.

The Laboratory's service ineludes diagnostie facilities to identify agents causing disease outbreaks of suspected foreign origin. It also provides information on improved disinfectants and animal biological products for use in prevention, eradieation, and control programs.

Research actually got under way in the converted one-unit Laboratory in 1954 on the virus causing the domestic vesicular stomatitis, similar to foot-and-mouth disease but much milder in effects. This virus was seleeted to train the staff and to test the Laboratory's safety measures before researeh on dangerous foreign diseases was started on Plum Island. This research paid an additional dividend, however, in the diseovery that the virus of vesicular stomatitis can be grown on the kidney cells of guinea pigs and cattle tongue tissue (AGR. RES., May 1955, p. 3).

By 1955 the researchers were ready to tackle the foot-and-mouth virus. Before the year was out, they developed a similar method for growing the organism in cultures of swine and cattle kidney cells (AGR. RES., December 1955, p. 10). The new method provides a low-cost supply of this virus from materials readily available. It is an important step toward large-scale production of the virus for fundamental studies and toward development of improved methods of preventive vaccination.

As basic research at the Plum Island Animal Disease Laboratory progresses, valuable contributions not only to knowledge of animal disease but also to the entire field of medical scienee ean be expected. Furthermore, knowledge of specifie diseases and methods of combating them can help provide proteetion for foods and animal produets in this country and throughout the world. ☆

WHEN TO Bark Feed

fruits and vegetables

MICRONUTRIENT SPRAYS ARE BEST TAKEN IN WHEN THE TREE IS GROWING

BARK FEEDING of dormant fruit trees is one recourse an orchardist has where his soil lacks enough of certain minor mineral nutrients.

Deficiencies of micronutrients (minerals required in minute amounts) occur in many scattered soils in western irrigated areas, along the Gulf and Atlantic Coastal Plains, and possibly elsewhere. Some trace minerals, zinc and iron included, can't be supplied through the soil since they're converted to unavailable form by other soil constituents. That keeps plants from getting enough of the minerals naturally present or applied.

Foliar sprays are an effective means of applying nutrients, but some sprays—zinc and iron, for example—cause severe foliage burn under most conditions. Since those two are among the elements that can't be supplied through alkaline or certain other soils, dormant spraying is a practical solution. That makes it doubly important to know when trees are ready to take in the bark sprays.

Studies at USDA's Agricultural Research Center, Beltsville, Md., show that during complete dormancy nutrient sprays enter only through pruning wounds and other breaks—not normal bark. Absorption through bark occurs only after growth starts.

ARS plant physiologists C. P. Harley and L. O. Regeimbal and horticulturist H. H. Moon made these discoveries by treating apple trees with needed mineral elements and then testing the various tissues for presence of those elements. Treatments were made with nitrogen, phosphorus, and rubidium, but the same principles should govern a tree's receptiveness for zinc, iron, and other minor elements that you'd supply by bark feeding. Fortunately major nutrients—nitrogen, phosphorus, potassium—can be supplied through the soil.

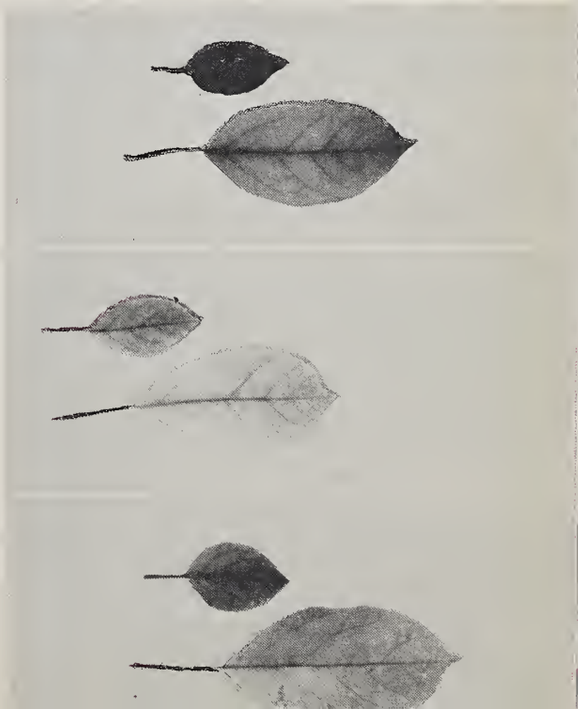
In these studies, urea was used for its nitrogen content, potassium acid phosphate for its phosphorus, di-ammonium phosphate for nitrogen and phosphorus, and rubidium chloride for the rubidium. The phosphorus in potassium acid phosphate and the rubidium chloride were in radioactive form for convenience in tracing, while the other materials were in conventional form and called for standard chemical analysis. Each compound was painted in bands around the branches of trees and the tests made periodically in various tissue layers in the treated zone and at various distances up and down the branches.

The scientists found none of the elements in question beneath the uninjured epidermis of treated trees during February—but *did* in phloem and xylem tissues where bark was scraped or cut. Early in April, when flower buds were in the green-tip to cluster stage but vegetative buds were still tight, substantial amounts of the nutrients showed up beneath normal bark that had been treated, even some distance from the point where applied. Of course, scraped or cut surfaces absorbed much more of the materials, but frozen wood took in somewhat less. It was clear that penetration in uninjured bark doesn't occur until the tree is growing.

Microscopic study of the branches showed why absorption takes place as new growth occurs. Since outer bark is inelastic, cambial growth produced many longitudinal cracks in the bark and transverse cracks at the leaf scars and lenticels. Rainwater, dew, and even the moisture normally transpired outward through the bark dissolves the nutrient salts and washes them through the cracks to the tree's absorptive phloem tissues.

The pattern of movement also is interesting. Once growth started, the materials moved inward and to some extent radially. After reaching the tree's up-and-down channels of transport, nutrients showed up at quite a distance, but especially in buds upward from the treated zone. Most of the nutrient went into the buds and shoots along the main channel of flow from a painted pruning wound. Around mid-April or a little later, greatest concentration was in the flower buds then developing most actively. At the end of April, the material was most concentrated in rapidly growing terminal leaves. ☆

RADIOPHOSPHORUS put on bark April 21 is dark in leaves in June 26 autoradiograph. Leaves got most nutrient through pruning cut (top pair), less through exposed phloem tissue (bottom), least through normal bark (middle). Great concentration was in a few small, early forming primary leaves. Many larger secondary leaves shared remnant, so each got less.



Amazing GIBBERELLIC ACID

It makes some plants grow 2 or 3 times as tall and may have practical uses

REMARKABLE acceleration in plant-height growth has been experimentally achieved with a little-known substance—gibberellic acid.

Preliminary studies also indicate that gibberellic acid may have potential for increasing the rate of growth and possibly the productiveness of a wide variety of crop plants.

USDA scientists working at the Agricultural Research Center, Beltsville, Md., have used one form of this chemical to double or triple the heights of many kinds of plants.

In greenhouse experiments, researchers applied gibberellic acid as a lanolin paste mixture externally to young stems. In 3 to 4 weeks, plants such as geranium, poinsettia, sunflower, rose, salvia, dwarf dahlia, petunia, and aster were up to 3 times as tall as comparable untreated plants.

The heights of crop plants such as snapbean, soybean, peanut, pepper, eggplant, corn, and barley were in many cases doubled or tripled by the chemical. In limited tests, direct application of the acid to several plant fruits—tomatoes, snapbeans, and peppers—did not affect growth.

New growth of young forest trees such as willow oak, tulip poplar, and maple was greatly increased following treatment. Similar treatment on two species of pine and white spruce, however, showed only a slight increase in growth of new shoots.

Weight of fresh young soybean and snapbean plants and amount of solid matter in them increased by 30 to 40 percent with gibberellic acid during the 2 to 3 weeks following treatment. Greenhouse tests showed that this chemical retarded the flowering of some ornamental and crop plants and advanced flowering in others.

Extremely minute amounts—as little as one-millionth of an ounce of the acid in 1 ounce of water—will make plants grow taller. Although all initial applications of the chemical were made by lanolin paste mixture, researchers are now using a foliar spray because it is easier to apply.

Gibberellic acid is one of many compounds that are under study in USDA's continued research on plant-growth regulators. Work on gibberellic acid is being conducted by ARS plant physiologist P. C. Marth, W. B. Audia, and J. W. Mitchell.

The acid is produced by the fungus *Gibberella* and is obtained experimentally by methods similar to those used in producing antibiotics. In Japan, the *Gibberella* fungus causes a serious rice disease characterized by excessive plant elongation, lodging, and reduced yields. Japanese scientists' early work on prevention of this disease showed the typical elongation of plants grown in sterilized media in which the fungus had been cultured. Chemicals responsible for the unusual growth in height were isolated. Later, USDA scientists initiated work on gibberellic acid in plant-growth studies. Its present experimental use as a major growth regulator on a wide variety of horticultural, agronomic, and forest-tree species is a new development.

Despite the fact that very small amounts of the acid are needed for

GIBBERELLIC ACID tripled heights of these plants. Acid was applied as 1-percent mixture. Untreated controls are at right of each plant.

increasing plant growth, further research is seriously hampered by a worldwide shortage. Methods for large-scale production have not been developed. Also, the acid's sudden recent prominence in plant-growth studies here and abroad have made it even more scarce and highly prized.

USDA experiments have been carried out with small supplies obtained from England, and Northern Utilization Research Branch, Peoria, Ill.

What is the future of this potential major plant-growth regulator?

The scientists are planning to expand their research in several ways as a result of their success in dramatically increasing plant growth.

They want to find out, for instance, if gibberellic acid can be used to increase plant height to give some plants an advantage over competing growths. By aiding rapid growth of young tree seedlings, for example, gibberellic acid may be of value in getting forest plantings started in a nursery or in a forest. Conceivably, it could give plants such as peanuts a needed spurt in growth to help the seedlings to develop past the early-growth stage where they frequently are destroyed by diseases. Preliminary experiments suggest that this chemical may be used to force seed production of biennial crops such as cabbage and beets in the first rather than the second season of growth.

Researchers want to find out, too, if gibberellic acid can be used to increase the dry weight of certain crops at harvest time—especially forage crops. Preliminary greenhouse tests have already indicated that the acid increased the total dry weight of one important field crop, soybeans, during the early period of growth. And it may have value for increasing production of other forage crops.

Scientists also want to know if gibberellic acid can be used to speed the growth of slow-growing plants such as pulpwood, that are in demand. ☆

poultry

How Turkeys Respond to Supplementary Fat

■ IMPROVED FEED EFFICIENCY AND GROWTH RESPONSE have been shown in some cases through the use of supplementary fat in turkey diets in preliminary feeding trials conducted by USDA poultry scientists.

In tests at the Agricultural Research Center, Beltsville, Md., 2 varieties of turkeys were fed an all-vegetable-protein diet plus 8 percent of stabilized lard. These turkeys gained more weight per pound of feed consumed than the control groups receiving no added fat.

Early-maturing Beltsville Small White poults receiving the fat-supplemented diet during a 13-week feeding trial consumed 17.9 pounds of feed per bird on the average and attained an average weight of 6.2 pounds. The control group of the same variety, receiving no added fat, used 20.1 pounds of feed per bird and weighed 6.1 pounds at 13 weeks.

Test birds of the Broad Breasted White variety receiving supplementary fat in their diets consumed an average of 13.4 pounds of feed per bird and weighed 5.6 pounds on the average at the end of a 10-week period. By contrast, the controls of the same breed used 15.1 pounds of feed per bird and weighed 5.1 pounds for the same feeding period.

Growth response to added fat in one experiment lasted 6 to 8 weeks in the early-maturing Beltsville Small White test birds and continued through 10 weeks in the Broad Breasted White turkeys. By the end of each of these test periods, however, growth response in the control birds on diets without supplementary fat began to catch up.

The Beltsville tests were begun by J. R. Sizemore, former member of the ARS poultry nutrition staff and were concluded by poultry husbandman J. J. Miner. According to Miner, the effect of the use of fat in the diets of turkeys and broilers is about the same. The calorie-protein ratio—that is, the proper relationship between energy and protein—is involved and may change according to the age of the birds.

In the experiments recently completed, the lard used contained an anti-oxidant to prevent rancidity. The lard was melted and added to a small quantity of the feed in a premix. This was then mixed with the remainder of the feed so as to thoroughly distribute the added fat. ☆

POULTRY PROCESSING and TENDERNESS

■ OUR COUNTRY'S POULTRY INDUSTRY RECOGNIZES the need for highest possible tenderness in frozen chickens and turkeys. Maintaining this tenderness with modern large-volume, highly mechanized processing methods, however, calls for new information on the tenderizing process.

Much of this need is being met by USDA research on poultry tenderization at the Western Utilization Research Branch, Albany, Calif. Work here gave useful information on such phases of processing and use as duration of chilling and holding before freezing, cooking from the frozen state with little thawing, and mechanical removal of feathers.

Need for some aging in the unfrozen state was established by other researchers some time ago. Since freezing stops the natural process of tenderization, adequate holding in the chilled state before freezing seemed to bring about least toughness and best tenderness. Thus, the bird would be tenderized and the convenient practice of cooking from the frozen state or after brief thawing would not affect tenderness.

Results so far confirm reports that poultry gets more tender as birds are held for progressively longer aging at chill temperatures, from 1 to 24 hours. Most tenderization, however, takes place in the first 6 hours. Appreciable but less tenderization occurs between 6 and 12 hours. Little change occurs between 12 and 24 hours and beyond.

No tenderization was found to occur in frozen birds held as long as 9 months. In general, holding at chill temperatures after thawing tenderizes birds as effectively as holding in slush ice before freezing.

Tenderization developed at intermediate aging periods (3 to 12 hours) was variable. Researchers say it is difficult to establish a positive aging time to take advantage of economical early tenderization of some birds, and yet insure tenderness of all birds. In general, about 12 hours of holding before freezing insures best tenderness. Many processing plants are now using an overnight or 24-hour chill period before freezing, and report marked reduction in complaints of toughness.

Also studied were other factors that may cause differences in tenderness. These include fasting and exercise before slaughter, shocking, scalding temperature, and packing cut-up versus packing whole.

Of the factors studied thus far, beating by picking machines has caused most toughness. Higher scalding temperatures and longer scalding times also cause some—though not as much—toughness. The least beating and the shortest scalding time compatible with efficient processing-plant operation are tentatively recommended as desirable practices.

Work is continuing on a study of practical tests to establish best aging conditions under normal and economically feasible plant practices. Researchers are also investigating the basic chemical reactions taking place in natural tenderization. This should help develop sound and practical changes in processing for highest tenderness at lowest cost. ☆

■ VERY LITTLE HAS BEEN KNOWN about the amount of food lost during preparation, cooking, service, and as plate waste in institutions. Yet, if this loss is high, diets may not be nutritionally adequate and the cost of food will be unnecessarily great.

To acquire more information on the extent of food losses, USDA food economists in the Household Economics Research Branch obtained the cooperation of 4 institutions—2 homes for aged and 2 for children.

In one children's home, the food was prepared and served in individual cottages with 15 children to a cottage. The other 3 institutions served from 90 to 804 persons. In each institution, food coming into the kitchen, the amount discarded during preparation and service, and the amount left on plates were weighed to find out

■ MORE PEOPLE EAT processed foods now than ever before. And we are willing to pay a higher price for them if they save time and effort.

A recent report by scientists H. K. Burr and E. R. Wolford of USDA's Western Utilization Research Branch, Albany, Calif., cite these advances in the use of such foods:

At least one-third of all the coffee served in American homes today is made from instant products, and the number of users is growing rapidly. Sales of frozen precooked fishsticks rose from 7.3 million pounds in 1953 to 44 million pounds in 1954, a 6-fold increase in 1 year. Some 359 million cakes were baked in 1954 from packaged mixes, a 12-fold increase since 1947 when they first appeared. Present consumption of dry nonfat and whole milk amounts to 4¾ pounds per

INSTITUTION FOOD LOSS—HOW IT AFFECTS DIET

how much was eaten. Then nutritive values and costs were calculated.

The ARS economists found that institutions tend to divide their dollars among food groups much as families do. The "milk, cream, cheese, ice cream" and "meat, poultry, fish" groups together made up about half of the institutions' food budgets; this is a little more than most families spend for these items. The children's homes had slightly more milk.

The money value of food coming into institution kitchens ranged from 56 to 83 cents a person a day. These values include donated foods, especially milk, used by all four institutions. Two institutions augmented their supplies by home-producing milk and some pork and vegetables.

The amount of food lost, especially as plate waste, in the three large institutions is much larger than in a family situation. It amounted to 12 to 22 cents a person a day and is probably characteristic of many institutions of similar size and category. On the other hand, food losses in the children's cottage ran less than 4 cents a child and probably are similar to the food losses in a large family where the food budget is small and plate waste is held down to a minimum.

The food groups showing greatest proportionate loss were "leafy, green, and yellow vegetables," "potatoes and sweet potatoes," "meat, poultry, and fish," and "dry beans and peas, nuts." Those showing least loss were "milk, cream, ice cream, and cheese" and "citrus fruit and tomatoes."

Iron and niacin were the nutrients showing the highest losses, calcium and riboflavin the lowest. In the large institutions, losses ranged from 13 to 38 percent for all the nutrients calculated; in the small cottage, the range was from 3 to 10 percent.

When average nutritive values of the foods as received were compared with the 1948 Recommended Dietary Allowances, all institutions were found to have adequate food supplies. When losses were deducted, however, the old-age institutions were low or borderline for several nutrients—iron in both institutions, vitamin A and niacin in one, ascorbic acid in the other. The children's institutions did better in meeting the allowances.

This information will be used by USDA food economists in assessing the adequacy of institutional diets and in formulating food plans. Institution managers, too, find the data helpful in checking food practices. ☆

WE WANT STILL MORE OF THE PROCESSED FOODS

person, equivalent to about 25 quarts of fluid skim or whole milk.

Prior to 1947, production of frozen concentrated orange juice was negligible. Today, our per-capita consumption is equivalent to about 6 quarts of single-strength juice per year. The equivalent of another 2 quarts is used as canned single-strength and concentrated products. Thus, nearly two-thirds of our consumption of oranges is in the form of these convenient juice products.

There is a pronounced trend toward consumption of traditional foods of other cultures. Many Chinese, Italian, Mexican, French, and Kosher dishes are now in canned or frozen precooked form. In many cases, ingredients are not readily available to housewives, but the prepared food can be bought at any grocery.

The researchers foresee domestic use of some dehydrated foods such as onion flakes, dried eggs and egg products, and diced potatoes—now widely used by manufacturers. They also see widespread application of vacuum puff drying to new fruit and vegetable juices, possibly to milk and other liquid or pureed foods.

If cooking with radio-frequency energy should become common in our homes—and many believe it will—the equipment used would appreciably speed up the defrosting and heating time for precooked frozen foods.

Convenience foods will especially benefit the 3 out of 10 homemakers who work outside their homes and tend to choose foods that can be quickly prepared. The wider the variety of easy-to-use foods, the more varied will be their family diets.

Food processors, trying to improve the color, flavor, and stability of their products, frequently adopt handling, processing, and storage procedures that better preserve the nutritive value of the fresh product.

The ARS scientists predict that the future will see steadily increasing production of these convenience foods. Processors will do a larger share of the work of preparing food for the table, housewives a smaller share. Relative costs of many of the new foods will undoubtedly decrease as volume expands and competition becomes more vigorous.

Processed foods—making available papaya juice in Minnesota, crabmeat in Kansas, and enabling a Maine family to enjoy fresh strawberries in January—are rapidly becoming popular additions to our eating habits. ☆

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OFFICIAL BUSINESS

agrisearch notes

PERSONNEL openings for men and women exist at the Plum Island Animal Disease Laboratory, just off the coast of Long Island (see p. 7). Especially needed there right now are operating engineers. Also needed are personnel for numerous other support operations, including medical biology technicians, and trades and laboratory helpers, stenographers, and typists.

Daily transportation between island and mainland is at Government expense. The island has an excellent cafeteria.

Interested personnel may obtain a standard Form 57 at any post office or at the Personnel Office, Plum Island Animal Disease Laboratory, 25 Front Street, Greenport, L. I. Applications for any of the openings should be sent to the personnel office in Greenport.

"THIS IS YOUR RESEARCH and the more you know about it and give us your suggestions the better we can serve you." So Hazel K. Stiebeling, director of ARS home economics research, told American Home Economics Association visitors at USDA's Agricultural Research Center, Beltsville, Md., during their convention in Washington.

"The home economics research that Congress authorizes us to do is geared around three major questions," she went on. "What do people need in food, clothing, and housing and other goods and services? What goods and services are available for satisfying these needs, how can they best be used, and how widely are they used? What gaps exist between quantities being used and those research shows to be desirable?"

The home economists visited laboratories where staff members explained and demonstrated the methods and equipment used in their studies. The visitor saw laboratory animals used in nutrition experiments; methods for measuring color, flavor, texture, structure, and other characteristics of food; techniques in food analyses—microbiological, chemical, physical; and work on food preparation and preservation.

Textile and clothing researchers showed their work on testing of textiles and on developing methods for home care of household and clothing fabrics. Clothing exhibits available for loan were on display.

Use of modern equipment and measurement of energy expenditure required in household tasks were part of household equipment demonstrations. Findings from these studies and others designed to determine the counter and storage space needed in doing housework guided the planning of the new energy-saving kitchen recently built at the Center.

ESTHER L. BATCHELDER has been named chief of the Clothing and Housing Research Branch of ARS, succeeding Ruth O'Brien who retired March 31.

Formerly assistant chief of the Human Nutrition Research Branch, Dr. Batchelder has had many years of experience in home economics at both State and Federal levels. In 1954, she received USDA's Distinguished Service Award for her oustanding leadership in developing and directing research in foods and nutrition.

Her headquarters continue at the Agricultural Research Center, Beltsville, Md. She is in charge of research on problems relating to clothing and household textiles and to functional requirements, use, and care of the house and its equipment.

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